ERAM
En Route Automation Modernization

Capabilities & User Benefits

ERAM Mission Objectives

- Modernize key components of the En Route automation system to enable user benefits

- Establish a new automation processing architecture that eliminates existing roadblocks to enhancing efficiency, capacity, security, and flexibility and enables information sharing

- Replace the legacy En Route software with new subsystems and tools that support the objectives of the Agency's modernization initiatives including the OEP, Free Flight, & Security

- Provide the tools necessary to enhance the benefits potential of existing and planned systems in the NAS

- Enhance the overall availability of the NAS by reducing impacts from planned and unplanned system outages

- Establish a modern, secure, open standards, and ICAO compliant system architecture upon which new capabilities can be developed and rapidly deployed to address changing needs

ERAM Principles for Project Execution

- Incrementally develop and deploy capabilities, starting with a manageable set of requirements and building on those capabilities with lessons learned and feedback from the user community

- Ensure program objectives are clearly understood by necessary parties, baseline those objectives, hold the line on cost and schedule, and ensure user buy in at each step of the program

- Avoid coupling between programs to the maximum extent possible and manage risks within each subsystem of ERAM to ensure overall success

- Where program coupling exists, develop well defined interface specifications and minimize system technical dependencies

- Provide a mechanism to leverage the Agency's research work and integrate those activities into the evolution of the ERAM subsystems

ERAM

User Benefits

Efficiency

Availability

Capacity

ERAM
Operational Benefits for the Aviation Community

Flexibility

Predictability

Security

Operational Benefits for the Aviation Community

ERAM Will Increase the Flexibility of the NAS

Operational Benefits for the Aviation Community

ERAM Will Increase the Flexibility of the NAS:

- Improved ability to adjust to adverse conditions in the NAS (severe weather, En Route congestion, airport configuration changes, etc.) is provided through the use of:
  - automation support for assisted dynamic routing
  - establishment of common situational awareness of adverse conditions between ATC/TFM and users
  - retention of multiple versions of user flight plans and ability to process partial routes filings
  - retention of restrictions (static & dynamic) applied to flight plans for post-analysis of NAS system performance

Operational Benefits for the Aviation Community

ERAM Will Increase the Flexibility of the NAS:

- Integration of dynamic restriction information resulting from traffic flow management initiatives (GDPs, weather reroutes, etc.) into the results generated for the flight planning process improves coordination and execution of plans

- Providing detailed information as to why a flight plan is rejected enables the aviation community to rapidly and efficiently correct the flight plan

- Sharing ATM restriction and delay information in real-time improves the user's ability to plan flights that will be executed with minimal changes and maximum predictability

Operational Benefits for the Aviation Community

ERAM Will Increase the Flexibility of the NAS:

- Allowing users to perform trial planning with real-time feedback allows the aviation community the flexibility to work around flow constrained areas that result in changes to the system

- Airspace use is made more flexible and efficient through:
  - Improved ATC service in offshore and military airspace when feasible
  - Automation support for airspace redesign
  - Support for dynamic adjustments to airspace boundaries

Operational Benefits for the Aviation Community

ERAM Will Increase the Efficiency of the NAS

Operational Benefits for the Aviation Community

ERAM Will Increase the Efficiency of the NAS:

- Improved distribution of aircraft intent, aircraft position, and status information enables more efficient routings, and enhances overall situational awareness and predictability

- Improved utilization of surveillance data enhances radar tracking and accuracy of all radar targets

- Increased surveillance input capability provides greater coverage of service which increases capacity

- Improved communications between ATC traffic management and airline operations allows common management of established plans with improved results

Operational Benefits for the Aviation Community

ERAM Will Increase the Efficiency of the NAS:

- Improved interface between ATC and TFM systems
  - Allows delay and cancellation information to be made available to FDP

- User's ability to file their intent early in the process of planning allows ATC resources to be allocated to handle the anticipated traffic

- Integrated national airspace adaptation provides seamless flight data processing services for the users

Operational Benefits for the Aviation Community

ERAM Will Increase the Efficiency of the NAS:

- Employing aeronautical adaptation standards adopted by users allows compatible data exchanges between airborne systems and ground systems

- Utilization of restriction information consistently across trajectory modeling functions within the ATC and TFM systems improves the predictability of the NAS

- Controller access to user preferences and constraints minimizes changes to agreements reached between the traffic flow managers and users

Operational Benefits for the Aviation Community

ERAM Will Increase the Efficiency of the NAS:

- Inclusion of hold, delay, and route filed vs. actual flown information enables a better quality analysis of flight execution & NAS performance

- Information gained through the use of new NAS performance analysis tools will enable capacity improvements facilitating airspace redesign and dynamic route structuring

- Sharing of NAS status information (e.g. NOTAMs, PIREPs, etc.) enhances efficiency and situational awareness and allows for a rapid assessment of NAS system status

Safety   *Efficiency*   *Availability*

ERAM
Operational Benefits for Air Traffic Controllers

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Enhanced surveillance (track/alert) processing & accuracy enhances situational awareness and separation assurance

- Enhanced trajectory modeling accuracy enhances strategic planning and efficiency

- A common user interface and functionality across primary and backup systems as well as the elimination of differences in automation capabilities for inter-facility and intra-facility operations reduces controller workload and training

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Mitigate the impacts of severe weather and the effects on controller workload by providing an interfacility area of interest flight plan distribution and coordination capability

- Automation support for the implementation of coordinated changes to airspace definition in near real-time allows for dynamic access to military airspace during severe weather or high volume traffic which reduces controller workload

- Electronic access to ATC information (ATC graphical products, publications and procedures, NOTAMs, PIREPs, airport and aicraft data, local facility information, etc.) reduces controller workload and ensures proper use of dated materials which enhances the delivered service

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Improvements in automation support for the integration of TFM and flight data management functions reduces controller workload:
  - front to end route route conversion on initial filing
  - application of all static route restrictions for PAR/PDR & LOA/SOPs along entire route of flight
  - application of dynamic TFM route restrictions within a CDM determined outside time frame
  - reduction in controller and pilot workload associated with in the issuance/recordation of changes to active flight plans and increases safety by reducing verbal communications and opportunity for human error

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Improvements in automation support for the integration of TFM and flight data management functions reduces controller workload:
  - faster, efficient execution phase for TFM plans provides the capability for dramatically reducing the Planning Phase time required.
  - reduction in planning phase time increases the accuracy of the weather forecast model and predictions of traffic volume in the NAS
  - working from a more accurate model will reduce controller workload by reducing the need to change enacted TFM plans and will enhance the delivered service to the customer

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Improvements in automation support for the integration of TFM and flight data management functions reduces controller workload in determining applicability of amendments to flight data:

  - TFM tools identify Flow Constrained Areas (FCA's) and the specific flights impacted by sector loading and weather
  - "Go Button" functionality will allow reroute information for these flights to electronically pass directly to the operational sector working those specific aircraft
  - Reroute information will mature into a "Red Route" like capability without the assumption of the route being issued. The route would follow the aircraft from sector to sector until issued

Operational Benefits for the Air Traffic Controllers

Safety & Efficiency

- Enhancement to En Route, Terminal, and TFM automation interfaces will reduce controller workload associated with current manual coordination procedures:

  - Go Button functionality will reach the terminals via a two way interface with PDC and new states of a flight plan
  - A pre-clearance proposal, state of a flight plan allows for changes to routing from TFM or the customer without the assumed need to coordinate the change. (Time frame for changes prior to departure TBD based on performance)
  - Allows automated changes to routing for TFM initiatives and reduces controller workload associated with manual coordination

Operational Benefits for the Air Traffic Controllers

Efficiency

- Enhanced training infrastructure supports training on new capabilities and system configurations without dependencies on operational system software

- Advanced training platform supports high fidelity training and reduces equipment related on the job training time

- New training system increases the Agency's capacity for training controllers

Operational Benefits for the Air Traffic Controllers

System Availability

- Full function FDP and RDP primary and backup systems with no loss or degradation of critical services for controllers due to system failures

- Decoupling of mission critical and non-mission critical applications and modern software engineering practices ensures applications and functions fail independently of the system as a whole and allow rapid restoration from a degraded mode

- Increase in the reliability of system hardware and software increases the overall availability of the system

Availability

Efficiency

ERAM
Operational Benefits for the
AF System Specialists

Operational Benefits for the AF System Specialists

System Availability

- Full function primary and backup systems with multiple levels of redundancy allows for scheduled or unscheduled maintenance without impacting operations

- System enhancements support testing and certification of multiple releases without impacts to air traffic operations and training

- Decoupling of mission critical and non-mission critical applications, an increase in the reliability of system hardware and software, and enhancements such as functional partitioning and isolation, automatic failure detection and recovery, and security protection mechanisms increase system availability

Operational Benefits for the AF System Specialists

Efficiency

- Reduction in the number and types of displays as well as the various alarms and alerts for monitor and control and a common user interface across systems reduces workload, training costs, and increases efficiency

- Enhancement to first and second level support and system resource management tools allow for faster definition of system problems and solution implementation

- Integration with remote monitoring systems provides improved reporting and responses to system problems

- Reduced cost of ownership through the reduction in system baselines and the improved definition of system interfaces

Operational Benefits for the TFM Specialists

- Improved ability to coordinate system changes with the controllers

- Capabilities to remove assigned routes that are no longer needed

- Improvements in surveillance and flight data processing increases accuracy and predictive capabilities of TFM tools

- Improved predictability of the NAS provides the capability to better manage sector loading

- Improved management of flow constrained areas

- Tools that support post analysis and feedback on the results of TFM initiatives

Operational Benefits for QA, AS & P, CWSU Personnel

- Enhanced tools allow for improved coordination of system changes

- Automation support for airspace configuration changes allow for increased flexibility

- Enhanced tools to support search and rescue
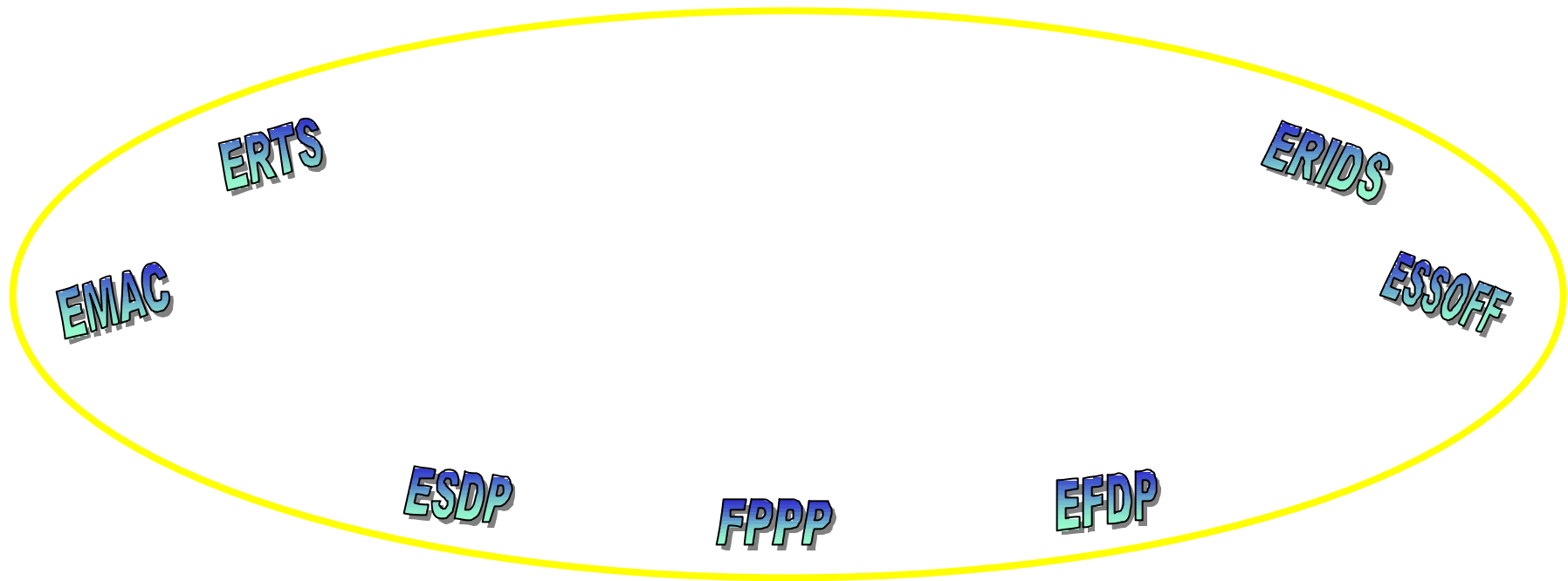
ERAM

Benefits Evolution and Implementation Strategy

ERAM Subsystems

En Route Training System

En Route Information Display System

Enhanced Monitor and Control

En Route System Support Offload

ERTS

ERIDS

EMAC

ESSOFF

ESDP

FPPP

EFDP

Enhanced Surveillance Data Processor

Enhanced Flight Data Processor

Flight Plan Pre-Processor

ERAM Functional Enhancements and Benefits - 2001

ERAM Accomplishments

- *First Phase of **ERIDS** system is operational at 1 Center*
- ***FPPP** prototype available for requirements development, user feedback and input (AOCs and MITRE CAASD)*
- ***EFDP**, **ESDP, EMAC, ESSOFF, LOA/SOP** prototypes available for requirements development and user feedback and input*

Other En Route/TFM Initiatives

- URET CCLD Build 1 operational in 1 Center in support of FFP1
- HCS A5f1.2 release supports common flight and radar data messaging to outboard automation through the CMS
- DSR BBC10 release supports continuous range readout and enhanced access to flight data from the R-Position
- DSR BCC20 release supports integration of URET and electronic grease pencil for controllers
- WARP WINS server supports weather interface to DSS tools
- Initial deployment of NOP to keysite

Sustainment/Tech Refresh Activities

- S-DARC deployed to X sites
- Initial deployment of upgraded flat panels for DSR D Positions as part of URET CCLD deployment

ERAM Benefits

- ***ERIDS** electronic access to ATC information (ATC graphical products, publications and procedures, NOTAMs, PIREPs, airport and aicraft data, local facility information, etc.) reduces controller workload ensuring proper use of dated materials and enhances the delivered service to the aviation community*

Other En Route System Benefits

- URET CCLD provides strategic detection of potential conflicts and supports approval of user requests
- DSR BBC10 release allows for more efficient spacing and routing
- National Offload Program supports enhancements to Air Traffic administrative functions

- S-DARC increases availability of RDP services on the backup channel

31

ERAM Functional Enhancements and Benefits - 2002

ERAM Accomplishments

- *ERIDS Phase 2 is deployed to 5 additional Centers and provides: an interface to TFM, interfacility communication, weather data, and real-time NOTAMs*
- *Continued FPPP prototyping; Phase 1 integrated with TFM*
- *Continued prototyping of EFDP, ESDP, EMAC, and ESSOFF and initial system testing*
- *ERTS deployed to keysite*

Other En Route/TFM Initiatives

- URET CCLD operational in 7 Centers in support of FFP1
- HCS A5f1.3 release upgrades interface to decision support tools and supports initial ICAO functionality
- DSR BCC21 release supports system assisted coordination from the datablock
- NEXRAD data available to the controller through WARP
- Initial A/G CPDLC Bld 1 capabilities available at 1 Center
- Initial ICAO flight plan processing interface with Mexico
- National Offload Program at all Centers

Sustainment/Tech Refresh Activities

- S-DARC available at all Centers
- HOCSR Phase III operational at all sites

ERAM Benefits

- *ERIDS allows sharing of NAS status information (e.g. NOTAMs, PIREPs, etc.) to enhance efficiency and situational awareness and provides initial automation link from TFM to sector*
- *ESSOFF allows*

Other En Route Benefits

- DSR BBC21 release reduces manual coordination (inter- and intrafacility)
- CPDLC Build 1 functions reduce controller workload and increase efficiency
- Enhanced weather products available for display in DSR enhance situational awareness

- URET CCLD design support interfacility flight plan processing independent of the Host
- HOCSR Phase III increases the reliability of HCS subsystems

ERAM Functional Enhancements and Benefits - 2003

ERAM Accomplishments

- *FPPP Phase 1 deployment with interface to En Route automation*
- *Keysite of ESDP interface to DSS tools*
- *Keysite of backup FDP capabilities and "Go Button"*
- *Prototype Area of Interest Flight Planning capabilities*
- *Continued prototyping of EFDP and common adaptation infrastructure and initial system testing*
- *ESSOFF Phase 1 at keysite*
- *ERTS initial deployment complete*
- *EMAC keysited as part of ECG*

Other En Route/TFM Initiatives

- URET CCLD operational in 10 Centers in support of FFP2
- HCS A5f1.4 release upgrades interface to DSS and supports additional ICAO functionality
- DSR BCC22 release supports integration of CPDLC enhancements at the R Position
- En Route Communication Gateway provides input capabilities at keysite for enhanced surveillance sources
- Initial automation interface to Canada

Sustainment/Tech Refresh Activities

- ECG refreshes the PAMRI @ the keysite
- Initial deployment of upgraded flat panel technology at DSR R Positions
- DSR and Host system recording storage systems upgrade with high capacity storage technology as part of ESSOFF

ERAM Benefits

- *FPPP Phase 1 provides detailed information as to why a flight plan is rejected and enables the aviation community to rapidly and efficiently correct the flight plan*
- *ESDP supports increased track data accuracy for Decision Support System tools which enhances strategic planning and the predictive capabilities of TFM tools*
- *ESSOFF enhancements to first and second level support and system resource management tools allow for faster definition of system problems and solution implementation*
- *EMAC reduces the number and types of displays as well as the various alarms and alerts for monitor and control and provides a common user interface across systems which reduces workload and training costs, increases efficiency, and enhances system availability*
- *Initial backup EFDP capability increase NAS availability, reduce controller workload, and increase flexibility for testing and training activities at the sites*
- *Utilization of restriction information consistently across trajectory modeling functions within the ATC and TFM systems improves the predictability of the NAS*
- *Improved management of flow constrained areas and the ability to coordinate system changes to the controllers through automation allows for a faster and more efficient execution phase for TFM plans and the reduction in the planning phase time required*
- *Improved mgmt of sector loading (ESDP/LOA & SOP codification)*

Other En Route Benefits

- ECG provides increased surveillance input capabilities and capacity improvements and consolidates existing NAS system interfaces
- ECG system deployment and the HCS/DSR storage system upgrades increase the reliability of the En Route system
- URET CCLD capabilities are expanded to support enhanced conflict detection and resolution capabilities, a new interface to TFM automation, and backup FDP capabilities

33

ERAM Functional Enhancements and Benefits - 2004

ERAM Accomplishments

- *ERIDS deployment complete*
- *FPPP Phase 1 deployment complete; Phase 2 prototyping as part of EFDP*
- *ERTS deployment complete*
- *ESSOFF/EMAC deployment initiated*
- *ESDP supports ASTERIX, ADS-B sensor inputs, expanded surveillance coverage in Gulf of Mexico and the Caribbean, initial Terminal interface, and enhanced data to the controllers*
- *Keysite of Area of Interest Flight Planning*
- *EFDP prototype available for operational evaluation*
- *Continued prototyping of common adaptation infrastructure*

Other En Route/TFM Initiatives

- URET CCLD operational in 20 Centers in support of FFP2
- HCS A5f1.5 release is keysited
- DSR BCC23 release supports integration of CPDLC enhancements at the D Position and domestic RVSM
- En Route Comm Gateway is deployed nationally

Sustainment/Tech Refresh Activities

- HOCSR Phase IV initial deployment
- DSR D Position display upgrades with flat panel technology is complete
- DSR R Position display upgrades with flat panel technology complete
- Initial upgrade of DSR D and R Position processors
- DSr and Host recording storage system upgrades are complete at all sites

---

ERAM Benefits

- *FPPP Phase 1 supports the retention of multiple versions of user flight plans and the ability to process partial route filings (pre-departure), front to end route route conversion on initial filing, and the application of all static route restrictions for PAR/PDR & LOA/SOPs along entire route of flight, reduces controller and pilot workload associated with the issuance/recordation of changes to active flight plans*
- *ESDP improves ATC service in offshore airspace with enhancements in surveillance inputs and processing capabilities*
- *EMAC reduces the number and types of displays as well as the various alarms and alerts for monitor and control and a common user interface across systems reduces workload and training costs and increases efficiency*
- *High fidelity ERTS subsystem reduces equipment related OJT and increases the capacity of the system for training controller by providing an enhanced training infrastructure that supports training on new capabilities and system configurations without dependencies on operational system software and without impacts on the testing of system releases*
- ***Area of interest flight planning capability mitigates impacts of adverse conditions in the NAS by reducing manual coordination and controller workload***

Other En Route Benefits

- URET CCLD capabilities are expanded to support enhanced conflict resolution capabilities, new interfaces to TFM automation, and backup FDP capabilities
- CPDLC Bld 1A upgrades provide increased number of user services and reduces controller workload
- HOCSR Phase IV increases the availability of HCS subsystems
- DSR console processor upgrades support enhancements to the controller user interface and increase the availability of the En Route system

34

ERAM Functional Enhancements and Benefits - 2005

ERAM Accomplishments

- *FPPP Phase 2 deployment complete*
- *ERTS enhancements support En Route automation evaluation*
- *Operational Test & Evaluation of EFDP*
- *ESDP is the primary surveillance source for En Route*
- *ESDP Terminal interface available at all Centers*
- *Initial deployment of common adaptation infrastructure*
- *ESSOFF & EMAC deployment complete*

Other En Route/TFM Initiatives

- Host
- DSR
- CPDLC

Sustainment/Tech Refresh Activities

- ECG refreshes PAMRI at all sites

ERAM Benefits

- *FPPP Phase 2 integration and application of dynamic restriction information resulting from traffic flow initiatives into the results generated for the flight planning process improves the coordination and execution of plans (pre-departure)*
- *FPPP Phase 2 utilization of restriction information consistently across trajectory modeling functions within the ATC and TFM systems improves the predictability of the NAS*
- *FPPP Phase 2 supports improved distribution of aircraft intent, aircraft position, and status information enables more efficient routings(pre-departure)*
- *User's ability to file their intent early in the process of planning using FPPP Phase 2 capabilities allows ATC resources to be allocated to handle the anticipated traffic*
- *Mitigate the impacts of severe weather and the effects on controller workload by providing an interfacility area of interest flight plan distribution and coordination capability*
- *FPPP retention of restrictions (static and dynamic) applied to flight plans for post-analysis of NAS system performance (pre-departure)*
- *Integration with remote monitoring systems through EMAC provides improved reporting and responses to system problems*

Other En Route Benefits

ERAM Functional Enhancements and Benefits - 2006

ERAM Accomplishments	Other En Route/TFM Initiatives	Sustainment/Tech Refresh Activities

ERAM Accomplishments
- *Initial deployment of core **EFDP***
- *Independent test capability implemented*
- *Full function backup available*

Other En Route/TFM Initiatives
- Host
- DSR
- etc.
- CPDLC Build 2
- Communications Gateway
- NADIN 2
- New DSR Backup Display Processor
- Full SAR
- Display System Manager

Sustainment/Tech Refresh Activities
- EDARC decommissioned
- DSR Backup LAN Replaced

ERAM Benefits

- *Automation support for assisted dynamic routing*
- *Common situational awareness of adverse conditions between ATC/TFM and the users*
- *Retention of multiple versions of user flight plans and the ability to process partial route filings (end-to-end)*
- *Integration of dynamic restriction information resulting from traffic flow initiatives into the results generated for the flight planning process improves the coordination and execution of plans (end-to-end)*
- *Improved interface between ATC and TFM systems allows delay and cancellation information to be made available to EFDP*
- *Enhanced function primary and backup systems with multiple levels of redundancy enhances allows for scheduled or unscheduled maintenance without impacting operations*
- *System enhancements support testing and certification of multiple releases without impacts to air traffic operations*
- *Elimination of differences in automation capabilities for inter-facility and intra-facility operations*
- *faster, efficient execution phase for TFM plans provides the capability for dramatically reducing the Planning Phase time required*
- *Reduction in planning phase time increases the accuracy of the weather forecast model and predictions of traffic volume in the NAS*
- *Working from a more accurate model will reduce controller workload by reducing the need to change enacted TFM plans and will enhance the delivered service to the customer*
- *TFM tools identify Flow Constrained Areas (FCA's) and the specific flights impacted by sector loading and weather / "Go Button" functionality will allow reroute information for these flights to electronically pass directly to the operational sector working those aircraft / Reroute information will mature into a "Red Route" like capability without the assumption of the route being issued. The route would follow the aircraft from sector to sector until issued (EFDP)*
- *Tools that support post analysis and feedback on the results of TFM initiatives*
- *Enhanced tools to support search and rescue*

ERAM Functional Enhancements and Benefits - 2007

ERAM Accomplishments	Other En Route/TFM Initiatives	Sustainment/Tech Refresh Activities
• *Full Service Primary and Backup* • *Full Redundancy* • *EFDP deployed nationally*	• Host • DSR • CPDLC Build 2	• Replacement and Removal of Legacy Host and DSR Primary LAN • Decommission Host and DSR

ERAM Benefits

- *Retention of restrictions (static and dynamic) applied to flight plans for post-analysis of NAS system performance*
- *Improved ATC service in military airspace*
- *Automation support for airspace redesign*
- *Support for dynamic adjustment to airspace boundaries*
- *Improved distribution of aircraft intent, position and status information enables more efficient routings (end-to-end)*
- *Integrated national airspace adaptation provides seamless flight data processing services for the users*
- *Controller access to user preferences and constraints minimizes changes to agreements reached between the traffic flow managers and users*
- *Inclusion of hold, delay, and route filed vs. actual flown enables a better quality analysis of flight execution & NAS performance*
- *Information gained through the use of new NAS performance analysis tools will enable capacity improvements facilitating airspace redesign and dynamic route structuring*
- *Common user interface and functionality across primary and backup systems*
- *Automation support for the implementation of coordinated changes to airspace definition in near real-time allows for dynamic access to military airspace during sever weather or high volume traffic*
- *Go Button functionality will reach the terminals via a two way interface with PDC and new states of a flight plan /A pre-clearance proposal, state of a flight plan allows for changes to routing from TFM or the customer without the assumed need to coordinate the change. (Time frame for changes prior to departure TBD based on performance) / Allows automated changes to routing for TFM initiatives and reduces controller workload associated with manual coordination*
- *Full function FDP and RDP primary and backup systems with no loss or degradation of critical services for controllers due to system failures*
- *Decoupling of mission critical and non-mission critical applications and modern software engineering practices ensures applications and functions fail independently of the system as a whole and allow rapid restoration from a degraded mode*
- *Increase in the reliability of system hardware and software increases the overall availability of the system*
- *Reduced cost of ownership through the reduction in system baselines and the improved definition of system interfaces*
- *Improved ability to coordinate system changes to the controllers*
- *Capabilities to remove assigned routes that are no longer needed*
- *Improvements in flight data processing increased accuracy and predictive capabilities of TFM tools*
- *Improved mgmt of sector loading (ESDP/LOA & SOP codification)*